

## Soil test based phosphorus recommendation for potato

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**Abstract:** Field experiments were conducted at twelve centers of All India Coordinated Research Project on Potato representing different agro climatic zone to find out suitable dose of P in potato based on soil test during 2005-06 and 2006-07. Four treatments consisting of combinations of different levels of P based on soil test used in the study showed significant effect on yield of potato. Results revealed that soil having low P availability (= 10 ppm) responded to P fertilizers and there was a need of P application at all these centers 100-125% recommended dose of P gave best tuber yield and also net returns. In case of medium P availability soils (10 to 22 ppm), the 50-100% recommended dose of P fertilizer was found to meet P need of the crop and gave higher yield and also net returns. In case of high P status soils (= 20ppm), application of P did not respond by increased yield and 25% of recommended dose of P as maintenance dose in the soils with > 20 ppm P gave maximum tuber yield. The results clearly indicate that P may be applied based on soil test value across different agro climatic zone to economize P dose.

**Keywords:** phosphorus application, soil test, potato, agroclimatic zone

### Introduction

Phosphorus is one of the key nutrients required for higher and sustained productivity of potato and its influence on tuber yield is very well established. Phosphatic fertilizers are expensive and in developing countries like India, they are either imported or manufactured using imported raw material. Due to increase in cost in the recent past, there has been a decreasing trend in the amounts of P fertilizer applied in India (Sundara and Natarjan, 1997; Sundara *et. al*, 2002). At the same time, soils contain substantial reserves of total P, most of which remains relatively inert, and only less than 10% of soil P enters the plant-animal cycle. Upon addition to the soils soluble phosphates react with the constituents of the soil and form compounds which are less soluble, depending upon the soil type. In acid soils, the reaction products are aluminium and iron phosphates and in the predominantly calcareous soils, the reaction products are calcium phosphates. As a result most of the P applied (often as much as 90%) is rendered unavailable for crop uptake but is still retained in insoluble form. This is the reason

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that the potato based cropping system in different potato growing pockets generally show positive P balance resulting into its build up. Annual applications are often necessary to maintain adequate labile P. Thus, soils commonly have large reserves of 'fixed' P that could support long term crop requirements if it could be mobilized through appropriate soil management.

Maximum potato yield occurs when sufficient P is available during early vegetative development and the entire period of tuber growth. Total plant P uptake increases rapidly during tuber initiation, levels off to a constant rate during tuber bulking, and ceases with plant maturation occurs primarily through the transfer of P reserves from the vine and roots. Phosphorus uptake by potatoes is relatively low compared with uptake of potassium or nitrogen but similar to uptake of sulfur. The amount of P in the soil solution that is readily available for plant uptake is very small compared with the total amount of P in the soil.

A general blanket application of fertilizer leads to its poor efficacy and wastage of costly resources as well as of environmental pollution. This becomes more relevant in case of P as unlike nitrogen applied P remains in soil and adds to its build up. In addition, this has resulted in severe imbalance of nutrients in soil (Kumar *et al.*, 2009).

Keeping this in view, a multilocation experiment was conducted in the major potato growing states of India under the All India Coordinated Research Project on Potato during 2005-06 to 2006-07 to evaluate suitable dose of P based on soil test on P economy in potato. Exact quantification of Phosphorus fertilizer based on soil test is very important.

## Materials and Methods

Eighteen field experiments were conducted at eleven centres of AICRP (Potato) representing different agro-climatic regions of the India namely, Bhubaneswar (Orissa), Chhindwara (MP), Deesa (Gujarat), Dholi (Bihar), Hisar (Haryana), Kalyani (West Bengal), Kota (Rajasthan), Ooty (Tamilnadu), Patna (Bihar), Jalandhar (Punjab), and Pantnagar (Uttarakhand) with popular potato cultivars of the regions during 2005-06 and 2006-07 to investigate the soil test based P application in potato. Experimental details of the trial at different centers are given in table 1. The four manurial treatments involving P through inorganic fertilizer based on soil test based phosphorus recommendation for potato were applied as per table 1 and tried in randomized block design with four replications at all the centers. Soil of the experimental field was classified as low (=10 ppm), medium (10-20 ppm) and high (=20 ppm). At all the centers, Olsen's P method was used for testing

available P in the soil (Table 2). Initial available of "P" in experimental plots at some of the centers is given in table 3. At all the centres the crop was grown during *rabi* (winter) season following recommended package of practices except at Ooty centers where the trials were conducted in summer/kharif 2006 and 2007. Nitrogen was applied in two splits as per recommendation *i.e.* half at planting and rest at earthing up at 40 days after planting. Basal application of P and K was done using single super phosphate and muriate of potash respectively, as per treatments at the time of planting. Crop was harvested at maturity and tuber yield and numbers were recorded from all treatments. Data were analyzed separately for each centre following standard statistical procedure. For working out net return, price of potato was taken as per respective region.

## Results and Discussion

### *Potato tuber yield from soil having low P availability (=10 ppm)*

Soils of experimentation field at Bhubaneswar (Orissa), Chhindwara (MP), Dholi (Bihar), Hisar (Haryana), Jalandhar (Punjab), Ooty (Tamilnadu), Kalyani (West Bengal) and Kota (Rajasthan) had available P less than 10 ppm, therefore 75% of recommended P and 125% of recommended P were applied as T3 and T4 respectively (table 4, 5 and 6).

At Chhindwara, during both the year, total tuber yield (28 and 26.12 t/ha) and net return (Rs. 71580 and 88740/ha) were highest in treatment receiving 125% of recommended P applied followed by application of recommended dose of P (27.2 and 25.51 t/ha and Rs 69191 and 86455/ha), respectively. Highest total number of tubers was also obtained with 125% of recommended P application followed by application of recommended dose of P. During first and second years of experimentation the percent increase in yield was 2.9 and 2.4% and net return was 3.5 and 2.6%, respectively in the treatment receiving 125% recommended dose of P over 100% recommended dose of P. During both the year, application 125% of recommended P gave maximum numbers (447.3 and 442.9 thousand /ha,) followed by recommended dose of P (439.0 and 417.6 thousand /ha,).

At Dholi, the trial was conducted on soil with available P 18 kg/ha. Higher tuber yield (13.09 t/ha) and net return (Rs. 22450/ha) were obtained by the application of 125% of recommended P. The yield at recommended dose of P was though at par, the net return was Rs 4300/ha less as compare to 125% recommended dose of P.

The availability of P in the experimental plot before

**Table 1.** Experimental details of different locations for 2005-06 and 2006-7

Center	Year	Variety	Spacing (cm)	Date of Planting		Date of Haulm Cutting		Date of harvesting	
				1 <sup>st</sup> year	2 <sup>nd</sup> year	1 <sup>st</sup> year	2 <sup>nd</sup> year	1 <sup>st</sup> year	2 <sup>nd</sup> year
BHN	2005-06 & 2006-07	K. Jyoti	60x20	27.11.05	23.11.06	NR	-	28.02.06	21.02.07
CHN	2005-06 & 2006-07	K. Jyoti	60x20	29.10.05	11.11.06	11.02.06	21.02.07	27.02.06	08.03.07
DES	2005-06	NR	50x20	19.11.05	-	01.03.06	-	08.03.06	-
DHL	2005-06	K. Ashoka	60x20	02.12.05	-	03.03.06	-	25.03.06	-
HIS	2005-06	K. Bahar	60x20	17.10.05	-	09.01.06	-	06/03/06	-
JAL	2005-06 & 2006-07	K. Badshah	60x20	13.10.05	13.10.06	20.01.06	20.01.07	10.02.06	08.02.07
KAL	2005-06 & 2006-07	K. Jyoti	60x20	04.12.05	04.12.06	27.02.06	01.03.07	09.03.06	11.03.07
OOT	2006 & 2007	-	60x20	19.05.06	19.05.06	18.09.06	18.09.06	03.10.06	03.10.06
KTT	2005-06 & 2006-07	K. Badshah	60x20	14.11.05	07.11.07	15.02.06	07.02.07	03.03.06	22.02.07
PAT	2005-06 & 2006-07	K. Ashoka	60x20	21.11.05	01.12.06	17.02.06	19.02.07	27.02.06	19.03.07
JRH	2006-07	-	50x20	08.11.06	-	20.01.07	-	29.01.07	-
PNT	2006-07	K. Pukhraj	60 x 20	20.10.06	-	18.01.07	-	02.02.07	-

planting at Hisar was 22 kg P/ha (< 10 ppm). Total tuber yield and total number of tubers was highest in recommended dose of P followed by 125% of recommended P. However, the difference was not significant. These parameters were lowest where P was not applied. Net gain was highest in the treatment of

recommended dose of P (Rs. 37025/ha) and lowest without P application (Rs. 26365/ha). Which was Rs 1538/ha higher than net return at 125% of recommended P application.

At Jalandhar, recommended P application recorded higher values for total tuber yield (29.6 t/ha) and net returns (Rs. 39750/ha) followed by 125% of recommended P (28.4 t/ha and Rs. 35980/ha, respectively). The least values for these two attributes were recorded without P application (23.5 t/ha and Rs. 22150/ha, respectively). During second year, 125% recommended P application recorded higher values for total tuber yield (29.06 t/ha) and net returns (Rs. 38080/ha) followed by application of recommended dose of P (28.71 t/ha) yield and Rs.37050/ha net return). The total number of tubers were highest with application of recommended dose of P (477.4 thousand/ha) followed

**Table 2.** Treatments details for different locations of AICRP (Potato) centers based on soil test

T1	No phosphorus application	
T2	Application of recommended dose of P	
T3*	Application of P as per soil test value	
T4*	Application of P as per soil test value	
Soil test values: (Olsen's P)	T3*	T4*
< 10 ppm	75% of recommended P	125% of recommended P
10-20 ppm	25% of recommended P	50% of recommended P
>20 ppm	12.5% of recommended P	25% of recommended P

**Table 3.** Initial availability of "P" in experimental plots at different locations

Center	Available "P" (ppm)	P application in treatment		Year
		T-3	T-4	
Soil having low P availability (≤10 ppm)				
Bhubneswar	<10	75% of recommended P	125% of recommended P	2005-06
Chhindwara	<10	75% of recommended P	125% of recommended P	2005-06
Dholi	<10	75% of recommended P	125% of recommended P	2005-06
Hissar	<10	75% of recommended P	125% of recommended P	2005-06
Kalyani	<10	75% of recommended P	125% of recommended P	2005-06
Kota	<10	75% of recommended P	125% of recommended P	2005-06
Jalandhar	<10	75% of recommended P	125% of recommended P	2005-06
Jalandhar	<10	75% of recommended P	125% of recommended P	2006-07
Kalyani	<10	75% of recommended P	125% of recommended P	2006-07
Kota	<10	75% of recommended P	125% of recommended P	2006-07
Chhindwara	<10	75% of recommended P	125% of recommended P	2006-07
Ooty	<10	75% of recommended P	125% of recommended P	2006
Ooty	<10	75% of recommended P	125% of recommended P	2007
Soil having Medium P availability (10 -20 ppm)				
Patna	11.9 ppm	25% of recommended P	50% of recommended P	2005-06
Pantagar	12.50 ppm	25% of recommended P	50% of recommended P	2006-07
Patna	10.49 ppm	25% of recommended P	50% of recommended P	2006-07
Bhubneswar	12.70 ppm	25% of recommended P	50% of recommended P	2006-07
Soil having high P availability (? 10 ppm)				
Deesa	22 ppm	12.5% of recommended P	25% of recommended P	2005-06

by 75% of recommended P (447.2 thousand /ha). The tuber yield however, was statistically at par with recommended P and 125% of recommended P during both the year.

At Ooty, during both the year, tuber yield (34.73 t/ha), net returns (Rs.84613/ha) and total tuber numbers (690.1 thousand/ha) were higher with 125% recommended dose of P followed by application of recommended dose P. During second year, yield followed similar trend but the number of tubers were not influenced by the treatments.

At Kalyani, during both the year, the differences among treatments for yield were also non-significant except for total number of tubers which was highest at 75% of recommended P. Highest net return (Rs. 52851/ha) was recorded for the recommended dose of P. During second year, the highest yield of tubers (28.53 t/ha) and net return (Rs. 36586/ha) was recorded with 125% of recommended P followed by application of recommended dose of P (28.10 t/ha tuber yield and Rs.35639/ha net returns). These two treatments were statistically at par. Total tuber numbers (597.2 thousand /ha) were higher in treatment where 75% of recommended P applied.

At Kota, highest total yield (23.89 t/ha) and net returns (Rs. 55345/ha) were obtained in treatment receiving 125% of recommended P which was 4.4 and 6.9% higher as compared to application of recommended dose of P. Highest numbers of total tubers (688 and 642 thousand /ha) were harvested in treatment where P was not applied. During second year, the highest total yield (20.11 t/ha) was obtained in treatment receiving application of recommended dose of P was applied followed by 125% of recommended P (20.03 t/ha). The highest net returns (Rs. 38980/ha) were obtained with application of recommended dose of P followed by 125% of recommended P (Rs. 38047/ha). At Bhubaneswar, highest tuber yield (15.19 t/ha) was obtained with 125% of recommended P application which was significantly better than any other treatments and this treatment also gave the highest net return. Under low P conditions, application of recommended dose remains insufficient and optimum yield was not achieved at all the center. At these centers when 100-125% of recommended P was applied, yield improved. This result confirms the recommendation that at deficient soils application of P may be increased by 25% above recommended dose (Ess, *et al.*, 2003; Goswami, 2006; Goswami, *et al.*,

**Table 4.** Total yield (t/ha) in the soils having < 10ppm initial P at different locations

Treatments	Bhubaneswar		Chhindwara		Dholi		Hisar		Jalandhar		Ooty		Kalyani		Kota	
	2005-06	2005-06	2006-07	2005-06	2005-06	2005-06	2006-07	2006	2007	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	
T1	12.26	24.41	19.5	8.24	20.54	23.49	25.04	29.88	12.95	24.63	24.09	13.57	12.2			
T2	11.52	27.24	25.51	12.12	23.53	29.55	28.71	31.77	16.13	29.22	28.1	22.89	20.11			
T3	10.4	26.18	22.16	10.56	21.56	27.24	27.67	30.98	14.54	27.35	27.46	20.75	16.37			
T4	15.19	28.04	26.12	13.09	22.08	28.35	29.06	34.73	17.58	28.42	28.53	23.89	20.03			
SEd	1.1	0.78	0.81	1.37	0.65	1.82	0.57	6.15	2.88	3.01	1.82	0.67	0.77			
CD (0.05)	2.49	1.76	1.83	3.09	1.46	4.11	1.28	13.9	6.51	NS	4.12	1.52	1.74			
CV %	12.6	4.16	4.9	17.57	4.17	9.48	2.9	27.3	26.59	15.53	9.53	4.7	6.33			

T1: No phosphorus application, T: Application of recommended dose of P, T3: 75% of recommended P and T4: 125% of recommended P

**Table 5.** Total tuber number in the soils having < 10ppm initial P at different locations (thousand/ha).

Treatments	Bhubaneswar		Chhindwara		Dholi		Hisar		Jalandhar		Ooty		Kalyani		Kota	
	2005-06	2005-06	2006-07	2005-06	2005-06	2005-06	2006-07	2006	2007	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	
T1	400.3	389.7	337.2	244.4	280.5	303.1	418.9	575.5	450.5	492.0	453.5	688.9	642.6			
T2	330.1	439.0	417.6	239.6	317.5	396.5	477.4	622.4	535.2	580.7	596.7	618.4	566.7			
T3	369.4	415.5	367.7	228.0	293.2	401.9	447.2	600.3	498.7	611.6	597.2	606.3	493.6			
T4	399.1	447.3	442.9	271.4	311.2	402.3	439.4	690.1	574.2	552.4	529.9	500.6	424.2			
SEd	29.0	14.2	19.6	62.7	21.0	16.2	14.7	34.4	74.7	35.5	34.9	40.2	22.2			
CD (0.05)	330	439	418	240	318	397	477	622	535	581	597	618	567			
CV %	10.95	4.76	7.1	36.04	9.88	6.11	4.68	7.83	20.53	8.98	9.08	9.43	5.9			

T1: No phosphorus application, T: Application of recommended dose of P, T3: 75% of recommended P and T4: 125% of recommended P

**Table 6.** Net return (Rs/ha) in the soils having < 10ppm initial P at different locations

Treatments	Bhubaneswar		Chhindwara		Dholi		Hisar		Jalandhar		Ooty		Kalyani		Kota	
	2005-06	2005-06	2006-07	2005-06	2005-06	2005-06	2006-07	2006	2007	2005-06	2006-07	2005-06	2006-07	2005-06	2006-07	
T1	-3772	60886	61205	5050	26365	22150	26950	48576	9418	40851	26969	15335	9844			
T2	-8590	69191	86455	22450	37025	39750	37050	71980	25756	52851	35639	50473	38980			
T3	-11649	65867	71802	15100	30128	33030	34230	69113	16942	47839	34654	42434	24265			
T4	7015	71580	88740	26750	31887	35980	38080	84613	33793	50064	36586	53963	38047			

T1: No phosphorus application, T: Application of recommended dose of P, T3: 75% of recommended P and T4: 125% of recommended P

2009; Sud, *et al*, 2008 and Trehan *et al*, 2008).

### **Potato tuber yield from soil having medium P availability (10 -20ppm)**

Soils of experimental field at location namely Patna (Bihar), Pantnagar (Uttarakhand) and Bhubaneswar (Orissa), had available P (Olsons, P) between 10-20 ppm, therefore 25% of recommended P and 50% of recommended P were taken T3 and T4, respectively (table 7, 8 and 9).

At Patna, recommended P gave highest tuber yield (36.87 t/ha) and the net return (Rs. 65535/ha) followed 50% of recommended P. During second year also, the higher tuber yield (24.98 t/ha) was obtained at recommended dose of P, which was statistically superior to any other

treatments. The net return was also highest with recommended dose of P (Rs. 48349/ha) followed 50% of recommended P (Rs. 39818/ha).

At Pantnagar, the highest total yield (34.21 t/ha) were recorded in treatments where application of recommended dose of P applied which was significantly better than any other treatment. The 50% of recommended and recommended dose of P produced highest number of total tubers (487.1 and 459.7 thousand/ha, respectively). The net return was also higher in treatment receiving 50% of recommended P (Rs. 36219/ha) followed by recommended dose of P (Rs 34882/ha) as compared to other treatments. During first and second years, yield increased by 7.08 and 10.09% and net return increased by 11.4 and 21.042%,

**Table 7.** Total yield (t/ha) in the soils having 10-20 ppm and > 20ppm P at different locations

Treatments	Soils having 10-20 ppm*				Soils having > 20ppm **
	Patna		Pantnagar	Bhubaneswar	Deesa
	2005-06	2006-07	2006-07	2006-07	2005-06
T1	27.94	19.97	23.47	17.09	43.83
T2	36.87	24.98	34.21	22.54	46.21
T3	30.95	22.35	28.47	18.75	42.23
T4	34.43	22.69	32.37	20.69	45.69
SEd	2.82	0.94	0.67	0.61	3.35
CD (0.05)	6.36	2.1	1.51	1.38	NS
CV %	12.24	5.92	3.18	4.38	13.04

\*T1: No phosphorus application, T: Application of recommended dose of P, T3: 25% of recommended P and T4: 50% of recommended P for soils having 10-20 ppm

\*\*T1: No phosphorus application, T: Application of recommended dose of P, T3: 12.5% of recommended P and T4: 25% of recommended P for soils having =20 ppm

**Table 8.** Total tuber number in the soils having 10-20 ppm and > 20 ppm P at different locations

Treatments	Soils having 10-20 ppm				> 20ppm
	Patna		Pantnagar	Bhubaneswar	Deesa
	2005-06	2006-07	2006-07	2006-07	2005-06
T1	643.2	595.0	429.4	330.8	590.1
T2	796.7	630.9	459.7	460.5	601.9
T3	729.8	584.9	422.5	359.4	560.3
T4	725.1	637.3	487.1	439.4	580.7
SEd	61.3	47.6	10.7	8.4	33.9
CD (0.05)	NS	NS	24275	18935	NS
CV %	11.97	11	3.38	2.98	10.07

\*T1: No phosphorus application, T: Application of recommended dose of P, T3: 25% of recommended P and T4: 50% of recommended P for soils having 10-20 ppm

\*\*T1: No phosphorus application, T: Application of recommended dose of P, T3: 12.5% of recommended P and T4: 25% of recommended P for soils having =20 ppm

**Table 9.** Net return (Rs/ha) in the soils having 10-20 ppm and > 20ppm P at different locations

Treatments	Soils having 10-20 ppm*				Soils having > 20ppm
	Patna		Pantnagar	Bhubaneswar	Deesa
	2005-06	2006-07	2006-07	2006-07	2005-06
T1	40011	29553	14654.88	9252	154961
T2	65535	48349	34882.98	29154	162836
T3	48717	38648	27087.28	15399	145905
T4	58827	39818	36218.58	22699	163749

\*T1: No phosphorus application, T: Application of recommended dose of P, T3: 25% of recommended P and T4: 50% of recommended P for soils having 10-20 ppm

\*\*T1: No phosphorus application, T: Application of recommended dose of P, T3: 12.5% of recommended P and T4: 25% of recommended P for soils having =20 ppm

respectively at recommended dose of P as compare to 50% P application.

At Bhubaneswar, application of recommended doses of P gave the highest yield (22.54 t/ha) which was significantly better than any other treatments. The treatment not receiving any P resulted in lowest yield. Recommended dose of P also produced significantly highest number of tubers 460.1 thousand/ha. In terms of net returns, recommended dose of P produced highest return (Rs.29154/ha) followed by 50% of recommended dose of P (Rs. 22699/ha). Therefore, at these centers, as available P was in medium range, the recommended P application gets the best yield. However, statistically at many places 50% of recommended P did not decrease the yield significantly and was at par with recommended P (Ess, *et al*, 2003; Goswami, 2006;; Goswami, *et al*, 2009; Sud, *et al*, 2008 and Trehan *et al*, 2008).

#### **Potato tuber yield from soil having high P availability (=20ppm)**

Soils of experimentation field at Deesa (Gujrat) had available P (Olsons, P) more than 10 ppm, therefore 12.5% of recommended P and 25% of recommended P (T3 and T4) were taken. Results revealed non-significant differences among the treatments for tubers yield. Highest tubers yield (46.21 t/ha) was obtained at recommended dose of P followed by the treatment receiving 25% of recommended P (45.69 t/ha, whereas, maximum number of tubers were recorded in treatment receiving recommended dose P (601944/ha) followed by the treatment not receiving any P (590139/ha). Treatment that received 25% of the recommended dose of P recorded highest net return (Rs.163749/ha) followed by the recommended dose of P application (Rs. 162836/ha).

Since the soil was high in available P, no significantly effect of P application was observed. This is due to build up of available P has reached a level where response of its application may not be obtained in next few coming crops. However, minimum maintains dose od P may be applied to avoid the risk of yield loss in subsequent years, P level may get depleted and need to be supplemented with recommended dose based on soil test (Ess, *et al*, 2003; Goswami, 2006; Goswami, *et al*, 2009; Sud, *et al*, 2008 and Trehan *et al*, 2008).

Study to economize on P dose from fertilizer in different P status of soils in different location revealed that soil having low P availability (= 10 ppm) responded to P

fertilizers and there is need of P application. Thirteen experiments conducted at low P status soils (= 10ppm), at different centers 100-125% recommended dose of P gave best tuber yield and also net returns. However, in case of medium P availability soils (10 to 22 ppm), the recommended dose of P fertilizer was found superior compared to other treatments. Four experiments conducted at medium P status soils (10-20 ppm) 50% recommended dose of P or recommended dose of P was sufficient to meet P need of the crop and gave higher yield and also net returns. In case of high P status soils (= 20ppm), application of P did not respond. Therefore, finding clearly outlined the importance of soil test in efficiently use of costly P fertilizer and economize the cost of cultivation in soils testing high in P.

#### **References**

- Ess DR, Morgan MT and Parsous SD (2003) Implementing site-specific management: map-versus sensor-based variable rate application. <http://www-agcom.purdue.edu/Ag.Com/Pubs/SSM-2-W.pp> 1-9.
- Goswami NN (2006) Soil testing as a unique tool for integrated and balanced fertilizer use for optimizing production – issues, options and limitations. Key-note Address. Proc. Of the National Seminar on Soil Testing for Balanced and Integrated Use of Fertilizers, New Delhi p.3-19.
- Goswami NN, Subba Rao A and Biswas AK (2009) Soil testing for precision agriculture. Soil Science in Meeting the Challenges to Food Security and Environmental Quality. pp47-54
- Kumar M, Rawat Shashi, Jatav MK, Dua VK Lal SS (2009) GIS mapping of spatial variability of available nutrients for site specific nutrient management in potato. In Information Technology Application in Horticultural Crops. (Editors PM Govindakrishnan, JP Singh, SS Lal, VK Dua, Shashi Rawat and SK Pandey). pp 99-105.
- Sud KC, Upadhayay NC, Trehan SP, Jatav MK, Kumar Manoj and Lal SS (2008) Soil and Plant Tests for Judicious Use of Fertilizer in Potato. Technical Bulletin No. 91 Central Potato Research Institute, Shimla.
- Sundara B, Natarajan V and Hari K (2002) Influence of phosphorus solubilizing bacteria on the changes in soil available phosphorus and sugarcane and sugar yields. Field Crop Res. 77: 43-49.
- Sundara B and Natarajan V (1997) Effect of source and time of phosphorus application with and without phosphorus solubilizing bacteria on sugarcane. In: Proceedings of the Annual Convention of Sugar Technology Association of India, Goa, September 26–28, 1997, pp. 13–20.
- Trehan SP, Upadhayay NC, Sud KC, Kumar Manoj, Jatav M K and Lal SS (2008) Nutrient Management in Potato, Technical Bulletin No. 90. Central Potato Research Institute, Shimla 64.